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GB 1503682 **GB 0911608**
GB 1123517 **GB 0746101**
GB 1075404 **US 4217851**

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Selected US specifications from IPC sub-classes A23G B05C

(54) Coating apparatus and method

(57) Method and apparatus for coating food or similar products in which the product is subjected to a stream of charged coating material from electrostatic sprayer 3, the velocity of which is increased by gas pressure from pipe 10 such that the coating material captured by the surface of the product and remains so throughout subsequent storage and handling. The food is collected in wire basket 5 which is earthed via finnel funnel 4. Alternatively, food may be pressure spray coated by powder 9 being picked up by gas pressure and sprayed through adjustable double nozzle 14.

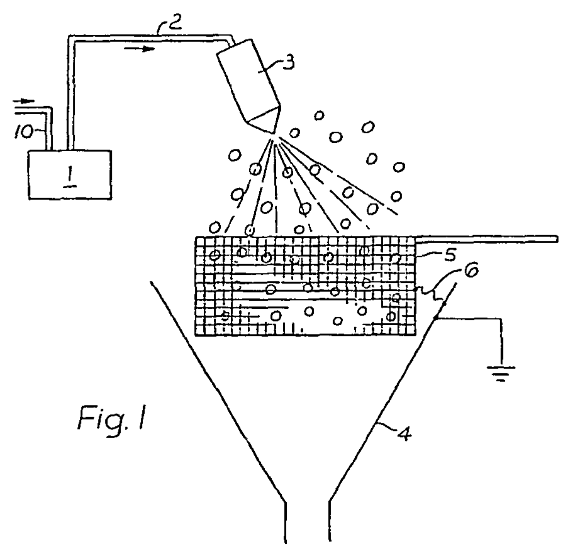

Fig. 1

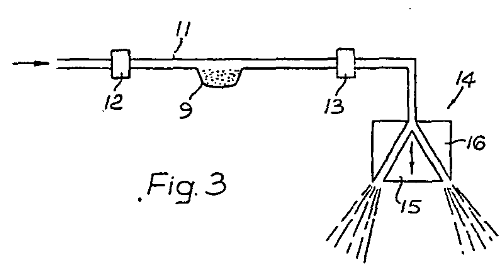

Fig. 3

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The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

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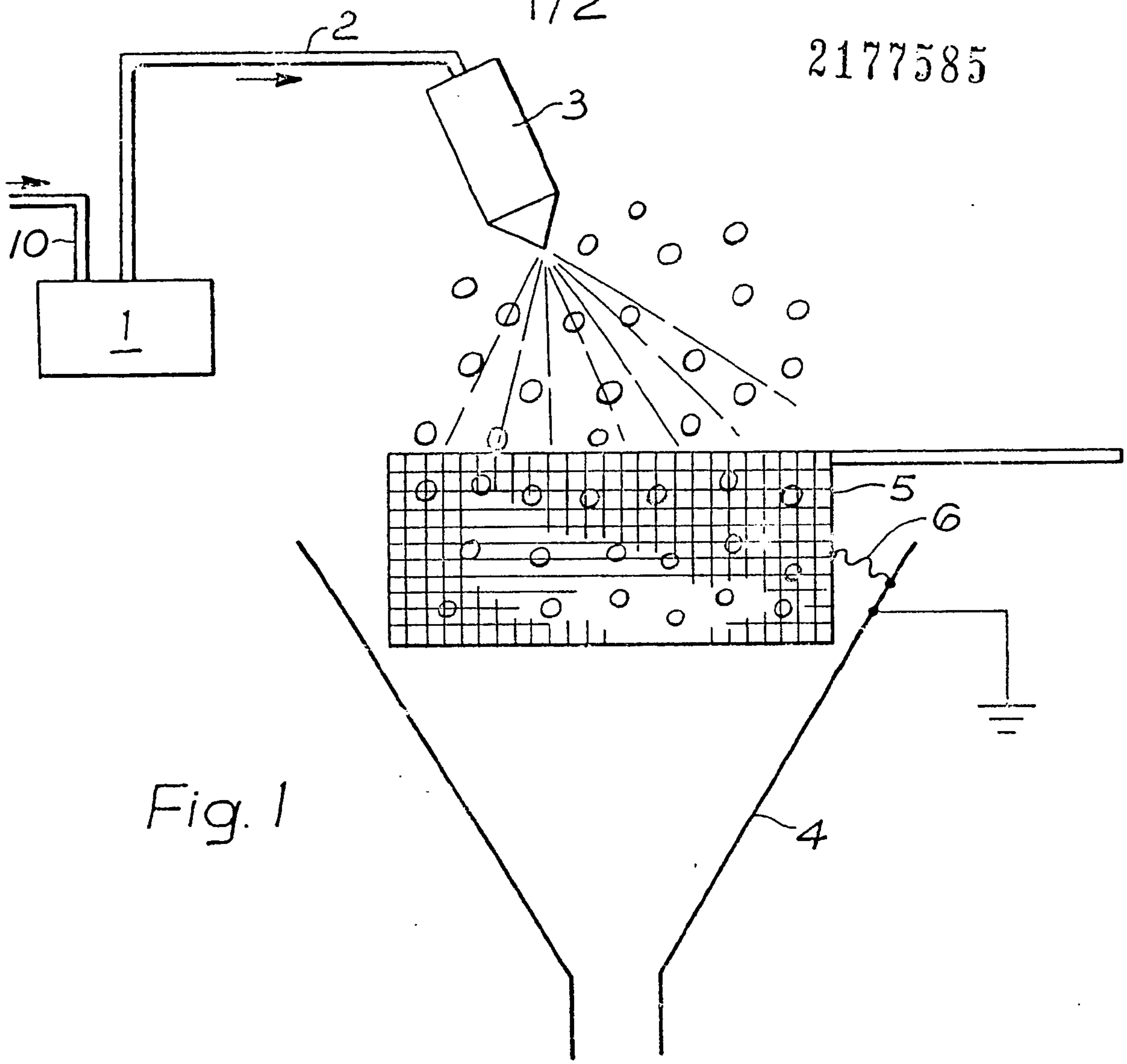

Fig. 1

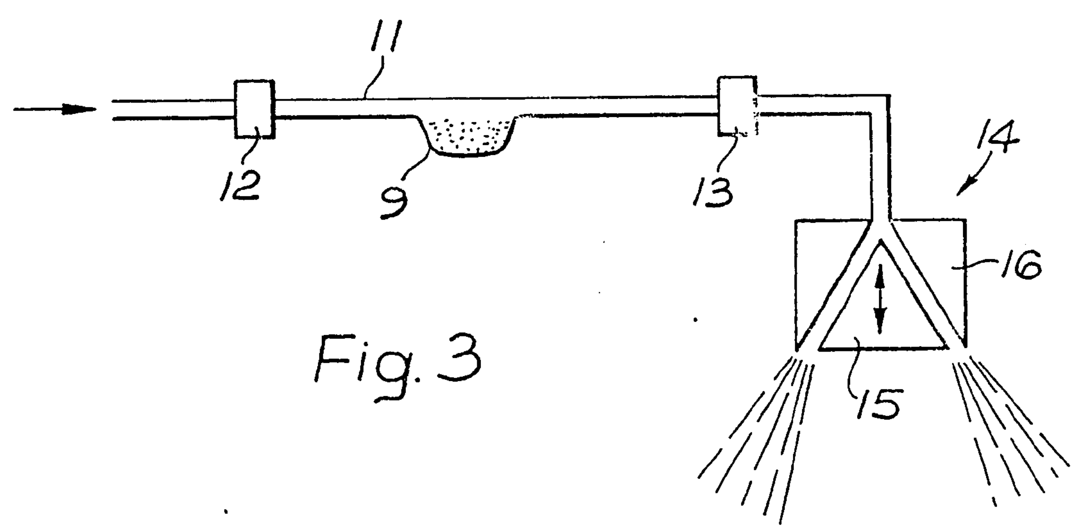

Fig. 3

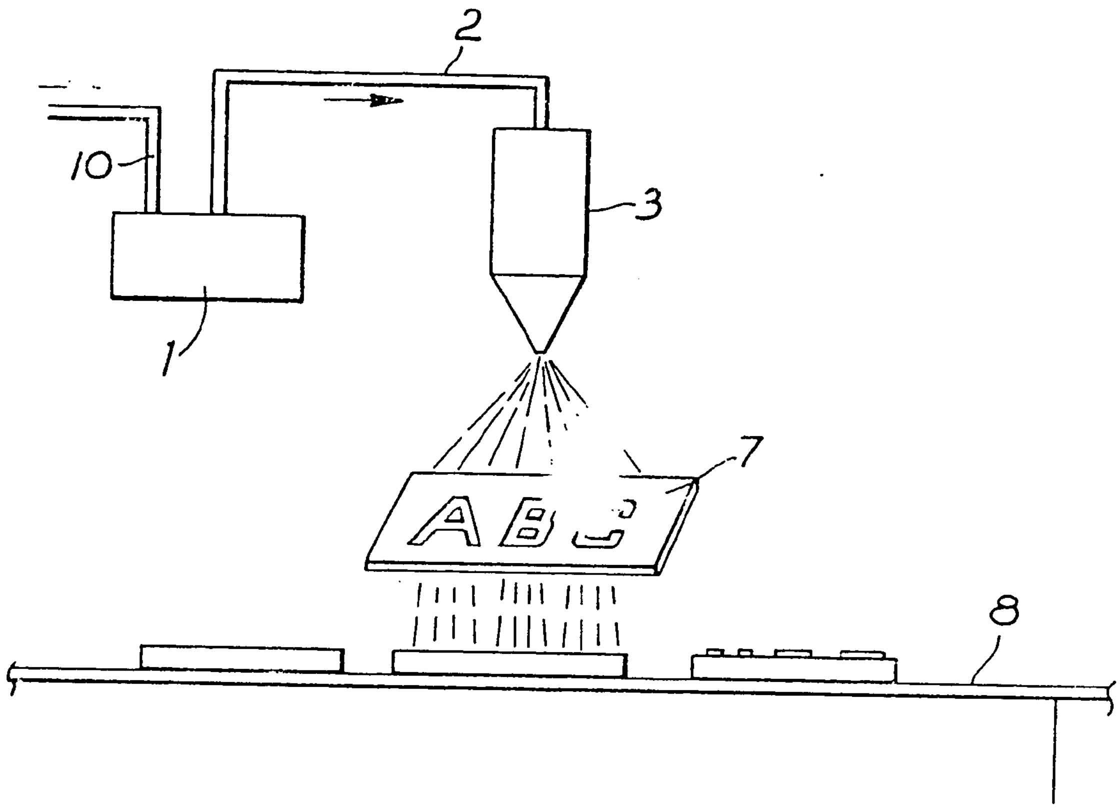

Fig. 2

SPECIFICATION

C ating apparatus and method

This invention relates to coating apparatus and a coating method in relation to the coating of assimilable products. The invention has been conceived in relation to the coating of food products and will be discussed primarily in relation thereto but is equally applicable to other assimilable products such as medicinal tablets and coarse powders.

Many food products, especially snack foods, are today coated to add flavour and/or visual effect and a common method of coating a snack food product is to spray the product with a fatty substance, such as a vegetable oil, and then apply a dry powder of the appropriate flavour and/or colour. The adhesion of the powder to the food product thus relies on the inherent adhesion afforded by the film of oil, or the like, and this leads to irregularities in the amount of powder on each piece of food product and a loss of coating during storage and handling. Also, the oil increases the fat content of the food product.

Another known coating method employs an emulsion of water and oil which carries the required flavour and/or colour and this is sprayed on to the food product. This method requires a dehydration step subsequent to spraying in order to provide a dry, stable product. Also, the adhesive properties of this coating are little better than that of the first coating method described above. These two methods are much used in the snack food industry.

In the biscuit industry, biscuits are often coated using a sugar or honey syrup, for example, and the biscuit subsequently dried or baked which is time-consuming and thus adds to the cost.

In the case of medicinal products, for example, it is often desirable to coat a tablet, perhaps to make it more palatable and/or to give it a distinctive appearance such as by colouration. The coating methods presently available are generally similar to those referred to above and thus suffer from the same disadvantages.

The primary object of the present invention is to provide a method and apparatus of spray coating any type of assimilable product which is relatively simple, and hence cost effective, and which results in a uniform coating with excellent adherence but without, in the case of a food product, increasing the fat content of the food product.

According to one aspect of the present invention, there is provided a method of coating an assimilable product comprising the step of subjecting the product to a stream of coating material the velocity of which is such that the coating material is captured by the surface of the product and remains so throughout subsequent storage and handling.

The coating material may be given the necessary velocity using gas pressure and may be given sufficient dispersion, to avoid non-uniform coating, by dispensing through a nozzle such as a double-cone arrangement, the inlet of which is at the apex and the outlet at the base.

However, the preferred method of coating is by a modified electrostatic spraying technique. This technique involves imparting a charge (which may be positive or negative) to the coating material, spraying it on the food product to be coated and allowing the food product to make at least intermittent contact with an electrically-conductive member which is poled so as to neutralise the charged coating material.

Thus the coating material is accelerated to the required velocity in the manner of a conventional electrostatic spraying technique in which the actual workpiece is electrically conductive and is poled so as to neutralise the charged spray. Therefore, the coating material is captured by the surface of the food product and remains captured when the electrical charge thereon has been neutralised.

The electrically-conductive member may be at earth potential or charged oppositely to the coating material, depending on the acceleration required of the coating material to give the latter the desired velocity which in turn depends on the nature of the surface of the food product and/or the coating material. In order to ease penetration, and at the same time assist neutralisation of the charged coating material, the product may be softened and/or moistened, such as by steaming, prior to spraying. The product and/or the coating material may be heated so that the coating material fuses on impact with the product. This is a particular advantage when coating powders to which further reference will be made hereinafter.

The coating method according to the present invention is suitable for both small-piece food products, such as breakfast cereals and snack foods, and for larger food products such as biscuits. With the small-piece food products, these require coating over the entire outer surface thereof and to this end they may be shaken in a wire basket, carried on a vibrating conveyor or suspended in a fluidised bed, for example, so as to tumble the product and so expose the entire outer surface thereof to the coating material. In the case of small breakfast cereal products, such as expanded or puffed rice for example, tumbling is effected automatically on exposure to the spray of coating material.

In the case of larger food products, such as biscuits, these often require coating only on one side. Thus they can be conveyed through the spray of coating material on an electrically-conductive member. If the coating is required in a particular pattern or perhaps in the form of lettering, figuring or pictures, a template may be arranged between the food product and the source of coating material. The template may be such as to form the required pattern, etc. with the actual coating material or so as to leave the pattern, etc. uncoated.

According to another aspect of the present invention there is provided apparatus for coating an assimilable product comprising a source of coating material, means operable to form the coating material into a stream having a given velocity, and means operable to move the product to be coated into the stream of coating material, whereby the coating material is captured by the surface of the product.

Preferably, the means operable to form the coating material into a stream comprise an electrostatic spray gun which charges the coating material (positively or

negatively as desired), and oppositely poled means to which the charged coating material is directed. The oppositely poled means may be at earth potential or charged oppositely to the coating material and may be in the form of an earthed metallic funnel into which the coated product falls. In the case of small food products such as breakfast cereals, the individual pieces will effectively tumble as they enter the funnel subjected to the stream of coating material, whereby they will be exposed to the latter over their entire external surfaces. For larger individual pieces of food product, such as snack foods, these may be contained within a metallic basket and shaken to tumble the product so as to effect the required overall coating. Alternatively, the food product may be conveyed on a vibrating conveyor or suspended in a fluidised bed. Instead of using a metal funnel, the process may be carried out in a booth of synthetic plastics material, with the product to be coated associated with means for neutralising the charge on the coating material such as the wire basket referred to above. The use of a synthetic plastics booth has been found to produce very satisfactory results although the reason is not fully understood.

If the food product is to be provided with a pattern, indicia or the like, as mentioned above, an appropriate template may be disposed between the food product and the stream of coating material so as to coat, or leave uncoated, the desired pattern, etc.

The means operable to form the coating material into a stream, may alternatively comprise a source of pressurised gas and a source of coating material, the pressurised gas being directed over the source of coating so as to pick up a portion of the latter and propel it towards the product to be coated.

The assimilable product also may be a medicinal tablet of capsule formed in the conventional way and subjected to the spray of coating material as described in relation to food products. The tablets or capsules may be softened, such as by steaming, prior to spraying if necessary. Furthermore, coarse powders, medicinal or otherwise, can be coated in accordance with the present invention. The great advantage of being able to coat a coarse powder is that the coating material may be given adhesive properties which then enables the basic powder readily to be pelletised without having to use the immense compressive forces necessary in some instances with the present production of medicinal tablets, for example. Nevertheless, the coating material can still impart the required palatability and/or colouring to the finished powder. However, the coated powder may well be acceptable as it stands without having to involve the pelletising step.

The ability to coat a coarse powder is also very advantageous outside the medicinal field: for example, some materials such as fruit and malt powders are very hygroscopic and therefore difficult to handle but can now be coated, using the present invention, with a material which will reduce the hygroscopicity of the basic powder. As with the other products referred to, the powder to be coated may be softened, such as by steaming, before coating.

The coating material may be in powder form but can be a liquid or emulsion, provided it can be atomised to effect the required penetration into the surface of the product to be coated. It will be appreciated that the coating may be varied to suit the product. In the case of snack foods, the coating material may be savoury, in the case of biscuits may be a sweetener, and in the case of medicinal tablets, capsules or powders may be such as to make it palatable and/or to control the release of the basic medicine into the consumer's body. In all cases the coating material can be coloured if desired.

Methods and apparatus for coating products in accordance with the present invention will now be described in greater detail, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic diagram of a preferred method and apparatus,

Figure 2 is a schematic diagram of a variation of Figure 1, and

Figure 3 is a schematic diagram of an alternativ method and apparatus.

Referring first to Figure 1, this illustrates a preferred coating method using an electrostatic spraying technique in the production of a food product. A source 1 of coating material in the form of a dry powder is connected by a pipe 2 to an electrostatic spray gun 3 which charges the powder to approximately +80,000 volts and ejects it through a nozzle generally towards a metallic funnel 4 which is at earth potential. Thus the positively charged coating powder is accelerated towards the oppositely poled funnel 4, the powder issuing from the spray gun in a dispersed stream which is necessary to avoid irregular coating. The coating powder is conveyed to the spray gun 3 by a pressurised gas which is connected to the source 1 by a pipe 10.

The food product is in this instance a crouton and the croutons fall through the stream of charged coating powder and in view of their relatively large size (typically of a width of about 18 mm) they tend not to tumble very readily in the stream of coating powder, whereby they are collected in a metallic wire basket 5 disposed in the mouth of the funnel 4, and the basket shaken or vibrated. The basket 5 is connected electrically to the funnel 4 at 6 and is thus at earth potential. Therefore, the charged coating powder is neutralised when it contacts the basket 5 or funnel 4, the latter requiring attention from time to time to remove excess powder therefrom which may be recycled.

The croutons or other food product coated in this way can be stored and handled without the coating which is substantially uniformly distributed, becoming loose which is a significant advance in the art. The croutons or other food product may be coated immediately after being cooked while they are still hot and soft, whereby the coating powder is captured by the surface thereof relatively easily. Alternatively, the food product may be cooled and stored and subsequently coated when required. In this case, the food product is preferably first moistened, such as by steaming, before being subjected to the spray of coating powder, the moisture softening the surface of the food product to aid capturing of the coating powder and also serving to improve the electrical conductivity between the food product and the earthed or negatively charged funnel 4 or basket 5 or indeed any other

member which serves the same purpose.

The coating powder may be flavoured and/or coloured as required and in the case of a crouton serving as a snack food, or any other snack food, this can be savoury such as cheese, meat flavour, spices or herbs. For other food products the coating powder may be sweetened, for example.

The apparatus of Figure 1 may be modified by omitting the basket 5 when a food product comprising relatively small pieces is being handled. For example, a breakfast cereal in the form of expanded rice will tumble automatically when being subjected to the spray of coating powder so that substantially uniform coating is achieved without any special means being employed to this end. An expanded rice cereal has been successfully coated in this way with carob powder, fruit powders, sugar, honey powder, malt flour, and malt extract powders. Also, flake-type breakfast cereals have been coated with malt flour, malt extract powders, sugar, and fruit powders, and cereal grains with honey powder.

When the food product is a biscuit or the like, it can be coated on one or both sides by subjecting it to the spray of coating powder, but if a pattern, lettering, figuring or pictures, for example, are required thereon, a template 7 may be disposed between the spray and the food product as indicated in Figure 2, the food product being carried on a metallic conveyor 8 which is at earth potential so as to neutralise the charged coating powder. The template 7 shown is such as to plate the coating powder on the food product in the form of letters of the alphabet but can be such as to coat the remainder of the food product surface, leaving the letters uncoated, i.e. the template can be either positively or negatively charged. The coating powder may be coloured if desired.

A further modification to the apparatus of Figure 1 is to replace the funnel 4 by a booth of a synthetic plastics material and to earth, or pole oppositely to the charged coating material, the basket 5.

Figure 3 shows an alternative method and apparatus which does not employ an electrostatic spray technique. In this embodiment, a reservoir 9 of the coating powder is arranged in a pipeline 11 which is connected to a source of a pressurised gas. Two valves 12, 13, which may be solenoid operated, are arranged one on each side of the reservoir, and a nozzle 14 is connected at the downstream end of the pipe 11. The nozzle 14 is of the double cone type with an inner cone 15 being adjustable relative to an outer cone 16 to vary the clearance therebetween which adjust the dispersion angle of the spray issuing therefrom.

In use, the two valves, 12, 13 are first both closed, valve 12 is then opened to place a charge of pressurised gas in the portion of the pipeline 11 between the two valves. Valve 12 is then closed and the valve 13 opened which effects a rapid release of the charge of gas, this release causing the charge to pick up an amount of the coating powder as it passes over the reservoir 9 and accelerate that powd r as a stream from the nozzle 14. This spray can then be employed as illustrated in Figures 1 and 2 or in other arrangements.

It will be appreciated that the coating method in accordance with the invention can be employed as a straight substitute for conventional coating techniques and permits a food product thus coated to be processed subsequently in whatever manner is required, for example toasting or frying prior to being cooled, with perhaps a drying step included. Furthermore, the food product can be cooked using normal baking techniques or by using an extruder cooker.

The resulting coated product is superior to that produced by known coating processes in that the coating is both substantially uniformly distributed and is virtually permanent, certainly from the standpoint of becoming dislodged on being subjected to normal packaging and storage methods and to normal handling by the consumer. Furthermore, the fat content of the food product is decreased in as much as no fatty substance is used in the coating process.

The charge imparted to the coating material in the electrostatic method according to the present invention is preferably as high as possible, consistent with practicable considerations, in order to achieve the desired velocity of the coating material. For example, voltages up to 300,000 (positive or negative) may be employed.

The nature of the charge is believed to be material specific in as much as some coating materials will perform better when positively charged and others when negatively charged. Experiments have shown that coating materials appear to adhere better to the base material when charged during application although the reason for this is not fully understood. In the illustrated embodiment of Figure 1, the coating material is charged using the corona charging technique but an alternative technique which may be used is that of tribo charging in which the coating material is electrostatically charged by friction during movement through a conveying tube or the like. In some instances a combination of corona charging and tribo charging may be employed.

In those cases where the target or base material has a porous surface, the charged coating material appears to be sufficiently securely captured for most commercial purposes, ie. from the standpoint of packaging, storing and handling as mentioned above. An example of a porous product is the production of a coated expanded rice cereal. Where the surface to be coated is relatively smooth or impervious, as in the case of medicinal tablets, the coating may not be permanently captured unless it is sealed in some way. This may be achieved by heat treating the base material and/or coating material before application of the latter, or by heat treating the product after coating, whereby the coating material is fused. Alternatively, the surface to be coated may be moistened before the coating material is applied, and then dried after application.

As already mentioned, the invention is applicable to assimilable products other than food products, for example m dicinal tablets, capsules and coarse powders. The basic coating methods of Figures 1 and 3 may be employed in these instances.

CLAIMS

1. A method of coating an assimilable product

comprising the step of subjecting the product to a stream of coating material the velocity of which is such that the coating material is captured by the surface of the product and remains so throughout subsequent storage and handling.

2. A method according to claim 1, wherein the coating material is given the required velocity using gas pressure.

3. A method according to claim 1 or 2, wherein the coating material is dispensed through a nozzle having a double cone arrangement the inlet of which is at the apex, and the outlet at the base.

4. A method according to claim 1, wherein the coating material is accelerated to the require velocity by inparting an electric charge to the coating material and subsequently neutralising that charge.

5. A method according to claim 4, wherein the coating material is charged positively.

6. A method according to claim 4, wherein the coating material is charged negatively.

7. A method according to any of claims 4 to 6, wherein the coating material is electrically charged using a corona charging technique.

8. A method according to any of claims 4 to 6, wherein the coating material is electrically charged using a tribo charging technique.

9. A method according to any of the preceding claims, wherein the product is moistened before the coating material is applied, whereby penetration of the coating material is facilitated as well as neutralisation of the charged coating material when such is employed.

10. A method according to any of the preceding claims, wherein the food product is shaken during the application of the coating material so as to expose the entire surface area of the product to the coating material.

11. A method according to any of claims 1 to 9, wherein the product is coated only over a given area thereof.

12. A method according to claim 11, wherein the coating material is applied through a template which is designed so as to define the given area of the product to be coated which may be in the form of lettering, figuring or other indicia or patterns.

13. A method according to any of the preceding claims and comprising the further step of effecting heat treatment to fuse the coating material when applied to the product.

14. A method according to claim 13, wherein the heat treatment step is effected by heating the product on application of the coating material.

15. A method according to claim 13, wherein the heat treatment step is effected by heating the coating material prior to the application thereof to the product.

16. Apparatus for coating an assimilable product comprising a source of coating material, means operable to form the coating material into a stream having a given velocity, and means operable to move the product into the stream of coating material, whereby the coating material is captured by the surface of the product.

17. Apparatus according to claim 16, and further comprising a source of gas pressure which is used to impart the required velocity to the coating material.

18. Apparatus according to claim 16 or 17, wherein the coating material is dispensed through a nozzle having a double cone arrangement the inlet of which is at the apex, and the outlet at the base.

19. Apparatus according to claim 16, wherein the coating material is accelerated to the require velocity by inparting an electric charge to the coating material and subsequently neutralising that charge.

20. Apparatus according to claim 19, wherein the coating material is charged positively.

21. Apparatus according to claim 19, wherein the coating material is charged negatively.

22. Apparatus according to any of claims 19 to 21, wherein the coating material is electrically charged using a corona charging technique.

23. Apparatus according to any of claims 19 to 21, wherein the coating material is electrically charged using a tribo charging technique.

24. Apparatus according to any of the preceding claims, wherein means are provided for moistening the product before the coating material is applied, whereby penetration of the coating material is facilitated as well as neutralisation of the charged coating material when such is employed.

25. Apparatus according to any of claims 16 to 24, wherein means are provided for shaking the food product during the application of the coating material so as to expose the entire surface area of the product to the coating material.

26. Apparatus according to any of claims 16 to 24, wherein the food product is suspended in a fluidised bed during application of the coating material so as to expose the entire surface area of the product to the coating material.

27. Apparatus according to any of claims 16 to 24, wherein the product is coated only over a given area thereof.

28. Apparatus according to claim 27, wherein the coating material is applied through a template which is designed so as to define the given area of the product to be coated which may be in the form of lettering, figuring or other indicia or patterns.

29. Apparatus according to any of claims 16 to 27, wherein means are provided for effecting heat treatment to fuse the coating material when applied to the product.

30. Apparatus according to claim 29, wherein the heat treatment is effected by heating the product on application of the coating material.

31. Apparatus according to claim 29, wherein the heat treatment is effected by heating the coating material prior to the application thereof to the product.

32. Apparatus for coating an assimilable product substantially as herein particularly described with reference to the Figure 1 or Figure 2 or Figure 3 of the accompanying drawings.

33. A method of coating an assimilable product substantially as herein particularly described with reference to Figure 1 or Figure 2 or Figure 3 of the accompanying drawings.

34. An assimilable product produced in accordance with the method of any of claims 1 to 15 and 32.

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